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Impact of temperature variation on haematological parameters in fish *Cyprinus carpio*

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Abstract

Common carp (*Cyprinus carpio*) is an important species in the area having a temperate climate of Himachal Pradesh. Temperature is an important factor which affects the immunological response. The present study was conducted to see the effect of seasonal variation of temperature on different haematological parameters in fish *Cyprinus carpio*. Blood samples were collected monthly, from Jan 2018 to May 2018. Average ambient water temperature ranges from 7 °C (Winters) to 23 °C (Summers). Blood samples were processed for haemoglobin, packed cell volume, RBCs count, WBCs count, MCV, MCH, and MCHC. The values of different parameters were found to increase with increase in temperature, but again decrease in the value of different parameters were seen as the breeding period arrives. This study suggests that temperature influence blood parameters of *C. carpio*.

Keywords: blood parameters, temperature, haematology

Introduction

Being a poikilothermic organism any change in ambient medium like temperature, salinity, food and the season may affect the growth of fish. Fish reared at optimal temperature may reduce the metabolic activity and reserves energy for the growth of fish [1]. In zone II of Himachal Pradesh temperature is less throughout the year and water temperature ranges from 7 °C to 25 °C from winter to summer. So there is interest in aquaculture of fish species that can survive and grow fast in cold water. *Cyprinus carpio* is one having such characteristics. Better understanding of the effects of environmental stressors on the health of fish may improve the fish welfare and also help to assess the relationship between these factors and to know the susceptibility of organisms to changing environments. It is necessary to develop control strategies based on a better understanding of the effects of environmental stressors on the health status of farmed fish [2].

Hematological parameters are increasingly used as indicators of the physiological stress response to endogenous or exogenous changes in fish. Haematological parameters are an important tool that can be used for effective and sensitive monitoring of physiological and pathological state of the fish. To know the susceptibility of organisms to changes in environmental conditions [3, 4]. Thus, seasonality dominates the life cycle of fish. It co-ordinates their reproductive activity, affects body weight and conditions, influences food intake and locomotor activity and is also believed to co-ordinate their blood parameters [5].

C. carpio is having high market value and consumer preference in this region of Himachal Pradesh. Tolerant to a wide variety of habitat make them important element for fish farming in this region of the state. Moreover, this fish are used as a model in a number of experimental studies [6]. The objective of the present study was to see the physiological response of *C. carpio* to a range of water temperature which the species faces during different months of a year.

Material and Method

The experiment was conducted in the department of Fisheries, COVAS, CSK Agriculture University Palampur. Fish were taken from the pond of length and weight. Blood sampling from three fish were taken every month from January to May for haematological analysis. Blood was collected with a syringe from caudal vein, and blood was transferred to EDTA vials and processed immediately for haematological analysis. Water temperature was also measured during this period. Hb was determined by using Sahli's haemoglobinometer. TLC determined by Nett and Herrick's solution and both RBC and WBC are stained and counting is done on

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Neubar chamber. The PCV was estimated by using micro-hematocrit reader and expressed in percentage. Erythrocyte indices mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) were calculated as per formulae of Dacie and Lewis [7].

$$\text{MCV} = \text{PCV} \times 100 / \text{erythrocyte count}$$

$$\text{MCH} = \text{hemoglobin} \times 10 / \text{erythrocyte count}$$

$$\text{MCHC} = \text{hemoglobin} \times 100 / \text{PCV}$$

Statistical analysis

The results are expressed as mean \pm S. E. To study the significance of the difference in the values of different parameters among samples of different months one-way analysis of variance (ANOVA) followed by Tukey-HSD test were conducted with the help of software Graph pad.

Table 1: Values of different blood parameters during month of January to May in fish *C. carpio*

	Month and temperature	January 8.3 °C	February 10.9 °C	March 13.2 °C	April 14.4 °C	May 20.6 °C
S. No.	Parameters					
1.	Hb (g/dl)	7.8 \pm 0.4 ^a	8.1 \pm 0.9 ^a	10 \pm 1.00 ^b	9.6 \pm 0.4 ^b	8.5 \pm 0.5 ^c
2.	PCV (%)	22.5 \pm 1.00 ^a	23.50 \pm 1.50 ^a	29.00 \pm 1.00 ^c	24 \pm 3.00 ^b	27.5 \pm 2.5 ^c
3.	RBC count (X 10 ⁶ /μl)	1.22 \pm 0.05 ^a	1.33 \pm 0.04 ^b	1.4 \pm 0.06 ^c	1.49 \pm 0.09 ^d	1.58 \pm 0.03 ^e
4.	WBC count (X 10 ³ /μl)	9.26 \pm 0.4 ^a	10.5 \pm 0.5 ^a	12.50 \pm 1.50 ^b	9.5 \pm 2.5 ^a	12.5 \pm 1.5 ^b
5.	MCH	60.00 \pm 2.5 ^a	60.51 \pm 4.7 ^a	71.9 \pm 10.2 ^b	64.50 \pm 1.21 ^c	53.58 \pm 1.97 ^d
6.	MCV	173.07 \pm 4.3 ^a	175.85 \pm 5.31 ^b	207.8 \pm 16.1 ^c	160 \pm 17.2 ^d	173 \pm 11.9 ^a
7.	MCHC	34.67 \pm 1.7 ^a	34.36 \pm 1.64 ^a	34.4 \pm 2.26 ^a	40.8 \pm 5.41 ^b	31 \pm 1.00 ^c

Values given as mean \pm standard error. Different letters (a, b, c, d, e) between the columns are significantly different (Tukey's test, $p \leq 0.01$) between different temperature during the months of sampling.

Discussion

In the present study lower values for all the parameters were found during winter months. Lowest values for all the parameters were found in the month of January. Which may be due to sharp drop in temperature during winter months lead to an increase in DO of water. So the carrier of the oxygen i.e. the hemoglobin will also decrease. Another possible reason for lesser values of blood parameters are non-availability of food in ecosystems due to lower temperature and reduced food intake during this period of the year [8]. All parameters show a gradual increase in value from January to May. There is a positive correlation between temperature and feeding. As *C. carpio* even stop feeding in this region during the winter season and represent the nutritional status of the fish. A slight decrease in the values of all the parameters except RBC count was observed in the month of April that may be associated with reproduction cycle. Erythrocytes are one of the most important in the determining of the erythrocyte characteristics significantly the efficiency of oxygen transport from the respiratory system to the tissues, especially changes in their number and volume could influence metabolic performance. This shows that the spawning period of *C. carpio* (in May) have revealed an abrupt change in the amount of erythrocytes. Gupta *et al.* [8] studied the seasonal fluctuations in *Tor putitora* and found that blood parameters were significantly lower during winter season and steadily increase with increase in temperature. Similarly, Guijarro *et al.* [9] found significant variation in white and red blood cells, hematocrit and hemoglobin in mature male and female of *Tinca tinca*.

The low leucocyte count was observed during winter season and may be due to suppression of pathogenic events in the water and led to immune suppression in fish. Low environmental temperature profound immunosuppressive effects on ectothermal animals like fish [10]. On the other hand, as the values of temperature increase the value of leucocyte

Results

The values of different blood parameters obtained during different months are given in table-1. During the experiment the water temperature was lowest in January (8.3 °C) and the highest water temperature was during the month of June (22.6 °C). During this period a significant change was observed in the values of all the parameters. As per the trend the values of all the parameters increase up to the month of March (T-13.2 °C) where the highest values for all the parameters were observed. But in the month of May again decrease in the values were seen. Tukey's test revealed that a significant change in the parameters was not seen between January and February, while a significant increase was seen in the month of March, furthermore a significant decrease in the values of different parameters were seen during the month of April and May.

count also increases and immune-stimulatory response has been observed and may be due to more pathogen exposure to the fish during warm months [11].

Conclusion

The present study suggests that hematological factors are affected by both endogenous and exogenous factors such as temperature and reproduction. These results obtained could improve the understanding of the influence of seasonal variations on the hemotological and biometric parameters in fish in order to optimize the husbandry practices.

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